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THE USE OF LASERS IN THE MILITARY SPHERE

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Abstract

This article focuses on the physics of laser radiation, its applications, and, in particular, its significance in the military sphere.

Keywords

holography, laser ranging, thermonuclear plasma, laser reconnaissance, optoelectronics, laser radar, lidar, bathymetry, laser gyroscope, clean nuclear bomb.

Аннотация: Данная статья посвящена физике лазерного излучения, его применению и, в особенности, его значению в военной сфере.

Ключевые слова: голография, лазерная локация, термоядерная плазма, лазерная разведка, оптоэлектроника, лазерный радар, лидар, батиметрия, лазерный гироскоп, чистая ядерная бомба.

Annotatsiya: ushbu maqola lazer nurining fizikasi, uning qo‘llanilish sohalari va ayniqsa harbiy sohadagi ahamiyatiga bag‘ishlangan.

Kalit so‘zlar: golografiya, lazer lokatsiya, termoyadro plazmasi, lazer razvedka, optoelektronika, lazerli radar, lidar, batimetriya, lazer giroskop, toza yadro bombasi.

In recent times, extensive scientific research has been conducted in the field of quantum electronics, leading to the development of a wide range of lasers and the study of their properties. Today, lasers are employed in positioning systems, telecommunications, space exploration and ground-based facilities, medicine, construction, computing, manufacturing, military technology, and various other areas. Furthermore, a new scientific discipline known as holography has emerged—a field whose development would be inconceivable without the laser. Another area within quantum electronics is laser-driven thermonuclear fusion, a process in which the creation of thermonuclear plasma would be impossible without a laser. Furthermore, there are applications such as laser isotope separation, the laser-based extraction of pure substances, and laser chemistry, among others. Today, lasers are also employed in the

military sector, with highly significant results. With the invention of the laser, humanity has effectively gained a tool that is now widely used in both scientific and industrial fields. We do not know yet, but perhaps in 50 years, thanks to advances in laser technology, a fantastic "revolution" will occur—one that might enable us to create a "time machine" and view the world as it was 50 years ago. Powerful lasers, concealed within spacecraft and satellites, could play a key role. It is also possible that a specialized mirror, positioned in orbit around the Earth, could direct light toward any point on the Earth's surface—with the capacity to destroy it. It is conceivable that powerful gamma-ray lasers could be deployed at great altitudes, capable of wiping out all living things in any city on the Earth's surface. There would be no escaping such a weapon—not even in underground tunnels—precisely because these are gamma-ray lasers. All of this is mere fantasy. May God spare us from such things ever becoming reality; everything depends on how humanity chooses to live today—as friends and brothers.

In the field of aerial reconnaissance, various foreign militaries employ a range of assets, including photography, television, infrared imaging, radio-based reconnaissance, and other methods. While photographic reconnaissance is considered the most valuable source of information, it has several drawbacks: for instance, objects cannot be detected in the dark, and the data processing time is significant. Television allows for the rapid transmission of information, but it is difficult to use at night or under adverse weather conditions. As for radio-based reconnaissance, it can operate at night and in poor weather, but it offers low resolution.

The operating principle of airborne laser reconnaissance is as follows. The area under surveillance—along with any specific objects within it—is illuminated by an onboard laser device. The radiation is reflected differently by various surfaces; consequently, each individual object exhibits a distinct level of reflectance relative to its background. This implies that an object can be camouflaged, meaning it can only be distinguished from its surroundings. Therefore, light reflected from the object itself and its surroundings is collected by the receiving optical system and directed onto a sensing element. The receiver converts the light reflected from the terrain and the object into an electrical signal, modulating its amplitude to produce a signal proportional to the level

of illumination. The laser reconnaissance system operates via frame-by-frame scanning, similar to a television system. Since the radiation strikes the aircraft under observation at a perpendicular angle, the system can capture the entire craft or generate a complete image on a television screen.

Laser light has long been used to measure long distances. Today, it is also employed in ground-based military equipment—for instance, in artillery and tanks—as well as in aviation (serving as a rangefinder, altimeter, and target designator) and in naval operations. The margin of error in such applications is only about 5 cm.

Portable laser rangefinders have also been developed for infantry use abroad, one version of which is designed in the form of binoculars. In this model, the light source and the receiver are housed in a single unit and equipped with light-emitting diodes (LEDs), ensuring equal effectiveness both day and night. The laser has a power output of 1.5 MW, and a photodiode paired with an amplifier serves as the receiver. As a result, it is capable of recording short, low-power pulses. Interference is eliminated by means of a specialized circuit. A compact rechargeable battery serves as the power source. The device's electronic components are based on integrated circuits, which means the total weight of such binoculars does not exceed 2 kg.

Similar distance-measuring devices are also installed on the tank and can perform 15 measurements per minute for a duration of 1 hour.

Laser ranging is a branch of optoelectronics based on determining the location of various objects using electromagnetic waves in the form of laser radiation. Objects targeted by laser ranging include tanks, ships, missiles, satellites, and various industrial or military facilities. This process employs an active method. Both laser ranging and radar-based ranging utilize three properties of electromagnetic waves:

1) 1) The property of reflection from an object. In this case, the target and its surrounding background reflect electromagnetic waves to varying degrees. The shorter the wavelength, the better it is reflected. Therefore, the development of lasers is of great importance for the future of laser-based positioning.

2) 2) The property of linear propagation and directivity. This capability is especially important for laser light.

3) The property of laser light to propagate at a constant speed. The shorter the duration of the pulse used, the better the effect.

Key advantages of laser energy systems:

Lightning-fast delivery, with no damage sustained during transit from origin to destination.

Damage potential, the ability to engage multiple targets simultaneously or rapidly switch between targets, and immunity to electromagnetic and gravitational effects. Although the initial development and production costs for laser weapons are significantly higher than those for kinetic weapons, the operational costs of directed-energy systems are much lower.

This is partly because, while traditional weapon systems are single-use (bullets, shells, mines, missiles), laser weapons have a virtually unlimited supply of ammunition.

Laser systems also have limitations related to the need to locate a target within the field of view, as well as requirements for positioning accuracy.Время наведения лазерной точки на целевой объект, затухание сигнала в атмосфере и проблемы, связанные с турбулентностью.

Over the past period, progress has been made in the development of high-power lasers; their efficiency has been significantly improved, and the feasibility of using laser systems in mobile applications has been demonstrated.

Extensive experience makes it possible to identify certain trends in the future development of directed-energy laser systems. The primary trends include the following:

- Reducing the scale of tasks—that is, choosing less protected targets;
- Transition to lasers with a shorter wavelength;
- A reduction in continuous-wave output power, accompanied by an increase in the efficiency of the radiation sources.

In the near future, the primary targets for the "atmospheric" use of directed-energy laser weapons will be "soft" miniature and micro-UAVs, as well as sensitive weapon-control system sensors and machine-vision systems.

The use of lasers for military purposes.

Military-practical tasks addressed through the use of laser radiation fall into two

groups. The first group involves the direct application of laser radiation against a target—including the destruction of the target, the infliction of irreversible damage, or the neutralization of an object so that it can no longer perform its combat mission. Laser systems employed for this purpose are known as directed-energy weapons. The second task involves using laser radiation to support conventional weaponry—for instance, for rangefinding, target designation and illumination, remote operation of combat vehicles, high-precision 3D positioning, and laser-based radar systems. It also encompasses countering an adversary's electro-optical equipment, as well as monitoring—using lidar—to detect and identify chemical, biological, or explosive substances in the atmosphere, or to conduct bathymetric surveys of the surface layers and shelf areas of oceans and seas. In addition, laser rangefinders, laser gyroscopes, and lidars are widely used in other sectors of the national economy.

In conclusion: Extensive research in the field of quantum electronics is currently being conducted worldwide. As a result, various types of laser devices are being developed, and significant effort is being directed toward their application. The scope of laser applications is expanding to such an extent that research is even underway into using lasers to sustain plasma in thermonuclear fusion reactions. Furthermore, lasers are employed for the separation of isotopes, the production of high-purity materials, the manufacture of "clean" nuclear weapons, laser chemistry, and more.

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